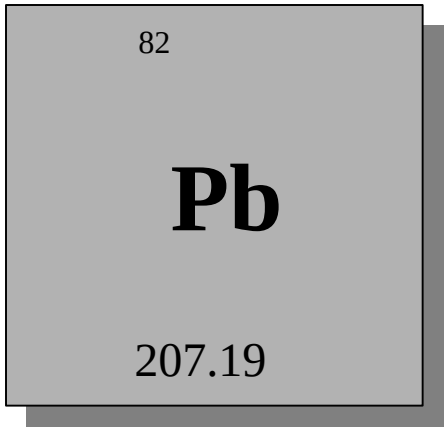
California Environmental Protection Agency

Air Resources Board

Risk Management Guidelines for New, Modified, and Existing Sources of Lead



Stationary Source Division
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Risk Management Guidelines for New, Modified and Existing Sources of Lead

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Acroymns and Abbreviations

AERMOD	American Environmental Regulatory Model
APCO	Air Pollution Control Officer
ARB	Air Resources Board
ASTM	American Standards and Testing Methods
BLL	Blood Lead Level
CAPCOA	California Air Pollution Control Officers Association
CDC	Centers for Disease Control and Prevention
CLPPB	Childhood Lead Poisoning Prevention Branch
DHS	Department of Hazardous Substances
District	Air Pollution Control District or Air Quality Management District
DTSC	Department of Toxic Substance Control
GM	Geometric Mean
GSD	Geometric Standard Deviation
H&SC	California Health and Safety Code
HRA	Health Risk Assessment
HUD	Department of Housing and Urban Development
IEUBK	Integrated Environmental Uptake BioKinetic
ISCST3	Industrial Source Complex - Short Term, version 3
km^2	squared kilometer
ln	natural logorithm
MEA	Maximum Exposure Area
MECR	Maximum Excess Cancer Risk
MOC	Maximum Offsite Concentration
NTIS	National Technical Information Service
OEHHA	Office of Environmental Health Hazard Assessment
REL	Relative Exposure Limit
RRAP	Risk Reduction Audit and Plan
SCREEN3	Screening version of the ISCST3 model
SRP	Scientific Review Board
TAC	Toxic Air Contaminant
T-BACT	Toxic Best Available Control Technology
µg/dL	microgram per deciliter
$\mu g/m^3$.	microgram per cubic meter
U.S. EPA	United States Environmental Protection Agency

Risk Management Guidelines for New, Modified, and Existing Sources of Lead

I. Introduction

A. Purpose of the Guidelines

In April 1997, the Air Resources Board (ARB or Board) identified inorganic lead as a toxic air contaminant (TAC). The primary basis for the identification was the health impacts associated with neurodevelopmental impairment in children. Other potential health effects identified were increased blood pressure in adults and cancer.

Lead is unique among the toxic air contaminants that the Board has identified in several ways. First, children are particularly susceptible to levels of lead in their blood due to exposure to lead. Second, the chronic non-cancer effects are related to blood lead levels as opposed to ambient air concentrations. These blood lead levels reflect current and past exposure from a number of sources; air emissions may only be a small part of the total exposure. Third, based on recommendations of the Office of Environmental Health Hazard Assessment (OEHHA) and the Scientific Review Panel (SRP), the Board did not identify a threshold level for acute or chronic non-cancer health effects due to exposure to lead air concentrations. Threshold levels are levels below which no adverse health effects are expected to occur. These levels are typically expressed as ambient air concentrations and are referred to as Reference Exposure Levels (REL). All previous estimates of non-cancer effects for identified toxic air contaminants were based on the use of an REL. For lead, no REL was given.

At the hearing, the Board recognized the challenges of risk management of inorganic lead because of the unique nature of the identification. Therefore, the Board directed the staff to work with affected parties, OEHHA, and the air pollution control and air quality management districts (districts) to develop risk management guidelines. As a result, we have prepared these Risk Management Guidelines for New, Modified, and Existing Sources of Lead (Guidelines).

In general, these Guidelines are designed to provide assistance to the districts in making risk management decisions for new, modified, and existing stationary sources of lead. We recognize that individual districts may need to tailor these Guidelines to their own specific air quality situations and needs. As such, these Guidelines should be viewed only as a framework for making risk management decisions at the local level.

These Guidelines fulfill the need to have a new procedure for making risk management decisions for exposure to lead. Specifically, the Guidelines:

- promote a consistent site-specific risk assessment approach to evaluating potential lead risk by establishing step-by-step procedures for quantifying cancer health risks and non-cancer neurodevelopmental impairment health risks in children. These procedures are based on the risk assessment information used in the Board's proceeding for the formal identification of lead;

- provide guidance on determining when to require application of the toxic best available control technology (T-BACT);

- provide guidance on making decisions concerning the issuance of permits for new and modified stationary sources; and

- provide guidance to the districts in setting public notification, significant risk, and unreasonable risk levels for the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (Hot Spots Program).

The Guidelines complement existing risk assessment and risk management guidance developed by the California Air Pollution Control Officers Association (CAPCOA) and the ARB (ARB, 1993, CAPCOA, 1993). OEHHA is developing new risk assessment guidelines, pursuant to the provisions of Senate Bill 1731. When the OEHHA guidelines become effective, they should be used where appropriate.

B. Development of the Guidelines

On June 17 and 20, 1997, we held initial public workshops in Los Angeles and Sacramento, respectively, to acquaint interested parties with the nature of the project and to invite them to participate in a workgroup that would assist us in developing the Guidelines. Subse-quently, the workgroup was formed and consisted of representatives of industry, several districts, the Department of Health Services, the Department of Toxic Substances Control, and OEHHA. In addition, several other organizations were sent copies of all correspondence. These organizations included the Natural Resources Defense Council and the United States Environmental Protection Agency (U.S. EPA).

The workgroup met seven times following the initial public workshops. We developed and circulated several of the draft Guidelines to seek comments on the technical approach and on the practical ability to implement the Guidelines on the local level. The Guidelines attempt to balance the uncertainty of the risk assessment process with the need to have a simple and direct method for quantifying the health effects as a basis for risk management decisions. The workgroup was not asked to reach a consensus on these Guidelines but rather individual members

submitted their comments during the public workshops. The workgroup has been invaluable in providing significant comments that have greatly assisted us in understanding the issues and concerns associated with the risk management process for lead and helping to develop a relatively simple approach for making risk management decisions.

We released the guidelines for public comment on September 6, 2000. On October 3, 2000, we held a public meeting to discuss the guidelines and comments we had received. We have addressed the public comments to the extent possible in this final version.

C. Structure of the Guidelines

The Guidelines are presented as three Chapters, with a series of technical appendices. Chapter I presents a brief introduction to the issues associated with lead risk management. Chapter II provides instructions for conducting site-specific risk assessments for the non-cancer and cancer health effects of lead. Chapter III provides specific risk management guidance for local air district permitting and Hot Spots Programs.

In Chapter II, we begin by presenting a simplified, screening-level approach to evaluate non-cancer risks using the neurodevelopmental risk as a surrogate. The approach uses conservative health-effect assumptions; therefore, projects that pass the criteria in this approach are very unlikely to pose a health risk. The rest of the chapter provides more detailed step-by-step approaches for estimating neurodevelopmental and cancer health risk.

For estimating the neurodevelopmental effect in the detailed analysis, we provide three tiers of analysis in order of increasing complexity and data requirements. Tier I is a screening level approach and uses default assumptions to estimate the potential health risk. On the other hand, Tier III is a more rigorous approach that uses site-specific blood lead level distributions and other site-specific information to estimate the potential health risk. We have used the tiered approach to accommodate the need for a simple screening tool, as well as a more refined tool to address particular situations. We have not provided a tiered approach for cancer risks as this analysis should be done consistent with existing procedures for assessing cancer risks.

The risk assessment information provided by OEHHA includes the tools to assess cardiovascular risk. However, we are not providing detailed instructions for estimating cardiovascular effects. We were concerned about the uncertainty in the dose-response relationship at blood lead levels one-half to one-third those seen in the studies on which the OEHHA assessment was based. After evaluating the options for making an assessment of cardiovascular effects, we concluded that our risk management recommendations based on neurodevelopmental effects were sufficiently health protective for adults and additional control for cardiovascular risk was

not justified. Therefore, we elected to omit the calculation of cardiovascular risk in these Guidelines.

In Chapter III, we present suggested levels for risk management decisions. As in Chapter II, we begin by presenting risk management levels for the simplified screening-level approach, followed by a presentation of risk management levels to use for the more detailed analyses. Specifically, we suggest trigger levels for requiring T-BACT, as well as suggested levels for approving and denying permits for new and modified sources. We also include suggested levels for public notification, significant risk, and unreasonable risk for districts to use in implementing the Hot Spots Program. Again, we emphasize that the risk management decision levels are only suggestions. The districts must make their own determinations in recognition of local issues and concerns.

In addition, the Appendices to this report provide much of the basis and rationale for these Guidelines. The reader is encouraged to read the Appendices. A brief description of each Appendix follows.

Appendix A discusses lead levels in the air and in blood, and trends in air lead concentrations and blood lead over the last few years.

Appendix B gives detailed instructions for retrieving information from the U.S. Census. The process of estimating neurodevelopmental risk outlined in these Guidelines uses census data. The census data can be accessed over the internet or from one of the Census State Data Centers listed in Appendix B.

Appendix C gives valuable background to the process for estimating neurodevelopmental risk. It also gives the basis for default values incorporated in the estimate of neurodevelopmental risk.

Appendix D discusses models used to relate air lead concentrations to blood lead. The non-cancer health effects are related to the blood lead levels. There are two ways to estimate blood lead levels from air lead concentrations. One has been used to derive a general factor that applies where the lead concentrations in the environment are unknown. The other takes into account lead concentrations in the environment and predicts the blood lead levels.

Appendix E outlines the procedure to follow when making arithmetic calculations with logarithmic data such as blood lead levels.

Appendix F provides an alternate approach to calculating neurodevelopmental risk for activities that will be emitting lead for less than 30 days.

Appendix G provides tools for evaluating sample size with regard to level of confidence and margin of error in blood lead sampling programs.

Appendix H discusses the risk management levels and the studies, reasoning, and regulatory precedents we considered in choosing levels to recommend to the districts.

Appendix I discusses findings upon which the district may base a decision to permit a source when risks are higher than the approvable level.

Appendix J briefly reviews the existing regulatory structure for airborne lead.

Appendix K contains the form for reporting to the Childhood Lead Poisoning Prevention Branch when a Tier II or Tier III study is planned.

D. Uncertainty in Health Risk Assessment

When lead was identified as a toxic air contaminant, the Board acknowledged that uncertainty exists when dealing with the quantitative correlation of potential health effects and exposure. At the hearing, the Board approved a preface to the identification report that discusses uncertainty. In essence, the preface indicates that the Board acknowledges and agrees with OEHHA and SRP that uncertainty exists when dealing with the quantitative correlation of potential health effects of exposure to low concentrations of inorganic lead[1]. The Board directed that, as risk management guidelines are developed, the uncertainties be taken into account and the science updated as appropriate. It should be noted that the preface was not reviewed or accepted by the SRP and was not intended to modify the SRP's findings on the inorganic lead report. The preface can be found in its entirety in the report titled "Proposed Identification of Inorganic Lead as a Toxic Air Contaminant, Staff Report/Executive Summary, April 24, 1997." The report can be accessed on the ARB's website at www.arb.ca.gov.

There is usually some degree of uncertainty associated with the process of risk assessment. This uncertainty arises from both the scientific process of risk assessment and the available data. There are two general areas of uncertainty: 1) uncertainty in the estimation of potency, and 2) uncertainty in the calculation of exposure.

[1] In the preface, 'low levels of air concentrations of inorganic lead' was defined as the statewide population-weighted average estimated to be 0.02 micrograms per cubic meter based on data collected in 1994-95. As shown in Appendix A, the statewide annual average has declined from 0.052 micrograms per cubic meter in 1990 to 0.017 micrograms per cubic meter in 1997. For additional information about air lead concentrations and trends, see Appendix A.

Effects of exposure to more than one carcinogen or toxicant are also not quantified in the risk assessment. Many examples of additivity or synergism (effects greater than additive) are known. For chemicals which act synergistically, the risk assessment could underestimate the risks. Some chemicals may have antagonistic effects (lessen the toxic effects produced by another chemical). For chemicals which act antagonistically, the risk assessment could over-estimate the risks. Additionally, there may be chemicals which pose health risks but are not considered in a given risk assessment for a number of reasons, including lack of information on toxicity; this could result in underestimating the risk.

The uncertainty in risk assessments is difficult to quantify, and, in most cases, the quantification of uncertainty is itself uncertain. The risk levels generated in a risk assessment are useful as a yardstick to compare one source with another and prioritize concerns. Consistent approaches to risk assessment are necessary to fulfill this function. This is one of the purposes of developing these Guidelines. Risk assessment results should not be construed as the expected rates of disease in the exposed population but are merely estimates of risk, based on current knowledge and a large number of assumptions.

1. Uncertainty in Estimates of Potency

There are three primary sources of uncertainty in estimating potency: 1) uncertainty in extrapolating dose/response estimates used to quantify health effects from animals to humans, 2) uncertainty in extrapolating from high doses to low doses, and 3) uncertainty in confounding factors that could obscure the actual magnitude of an association between exposure to the pollutant and an adverse health effect. In the case of the non-cancer neurodevelopmental effects of lead, there was no animal-to-human extrapolation and only limited high dose-to-low dose extrapolation in the studies used to develop the potency factors. Many of the studies were undertaken at current air or blood lead levels. The potential for confounding exists but the number and consistency of the studies indicate the health effects cannot be explained away by potential confounding and real health effects exist. Nevertheless, to illustrate the uncertainty and following general scientific guidelines, the OEHHA commonly calculates the 95 percent confidence intervals around their estimates of potency. These are shown in the "Technical Support Document, Proposed Identification of Inorganic Lead as a Toxic Air Contaminant, Part B Health Assessment" March 1997 (ARB, 1997), located on the ARB web site at www.arb.ca.gov.

2. Uncertainty in Estimates of Exposure

There are two primary sources of uncertainty in estimating exposure: 1) uncertainty in estimating or monitoring ambient concentrations, and 2) uncertainty in estimating baseline blood lead levels. Sources of uncertainty in estimating the ambient concentrations include the accuracy of the emission estimates, the quality of the meteorological data, and the accuracy of the dispersion model. Uncertainty in estimates of exposure based on monitoring data relate to measurement variability, sampling frequency, and siting issues. Sources of uncertainty in baseline blood

lead levels include other sources of exposure, metabolism, diet, behavior, sensitivity, and body burdens. There is a large degree of individual variability among humans even when the environmental concentrations are the same.

3. How Uncertainty is Addressed in the Guidelines

We have addressed uncertainty in these Guidelines in three ways. First, we estimated the neurodevelopmental risk to the children in a neighborhood as opposed to estimating the risk for a child or children that may be living in the location where the air dispersion model predicts the highest concentration. This is appropriate because the neurodevelopmental risk is based on the percentage of the population expected to have blood lead levels of concern. While we can calculate the probability of having a blood lead level of concern for an individual child, we can not have a high level of confidence in it if we do not know how much lead is in the soil, dust, water and other sources of exposure in that particular child's environment.

Second, we provided two exposure scenarios for the assessment of neurodevelopmental risk when default values are used for baseline blood lead levels. We believe it is prudent to limit increases in emissions of lead to the air for populations with greater potential for exposure from sources other than the source being evaluated. Thus, we have defined criteria for a high exposure scenario and selected baseline blood lead statistics to reflect that higher than average potential for exposure.

Finally, we provided a tiered structure which allows sources to chose from three increasingly site-specific options for estimating baseline blood lead levels.

II. Site-Specific Health Risk Assessments

This Chapter provides guidance on how to do a site-specific health risk assessment for lead. The health effects addressed are non-cancer and cancer effects. We are using the estimates of risk based on non-cancer neurodevelopmental impacts on children as a surrogate for both non-cancer neurodevelopmental and cardiovascular risks to adults. The information generated in this chapter is used with the information in Chapter III to make risk management decisions.

We begin by presenting a simplified screening-level approach to evaluate the non-cancer risks using the neurodevelopmental risks as a surrogate. This simplified approach is based on air concentrations and can only be used if the source is not located in a high exposure area. It is offered as a more conservative screening tool that should apply to most sources. It is an easier alternative to the more detailed approach for assessing neurodevelopmental effects. We then present more detailed approaches to specifically evaluate neurodevelopmental effects.

Finally, we present basic information on conducting a health risk assessment for cancer. Cancer health effects are evaluated in accordance with established procedures. These procedures require that the individual cancer risk from each carcinogen be summed to estimate the total facility cancer risk.

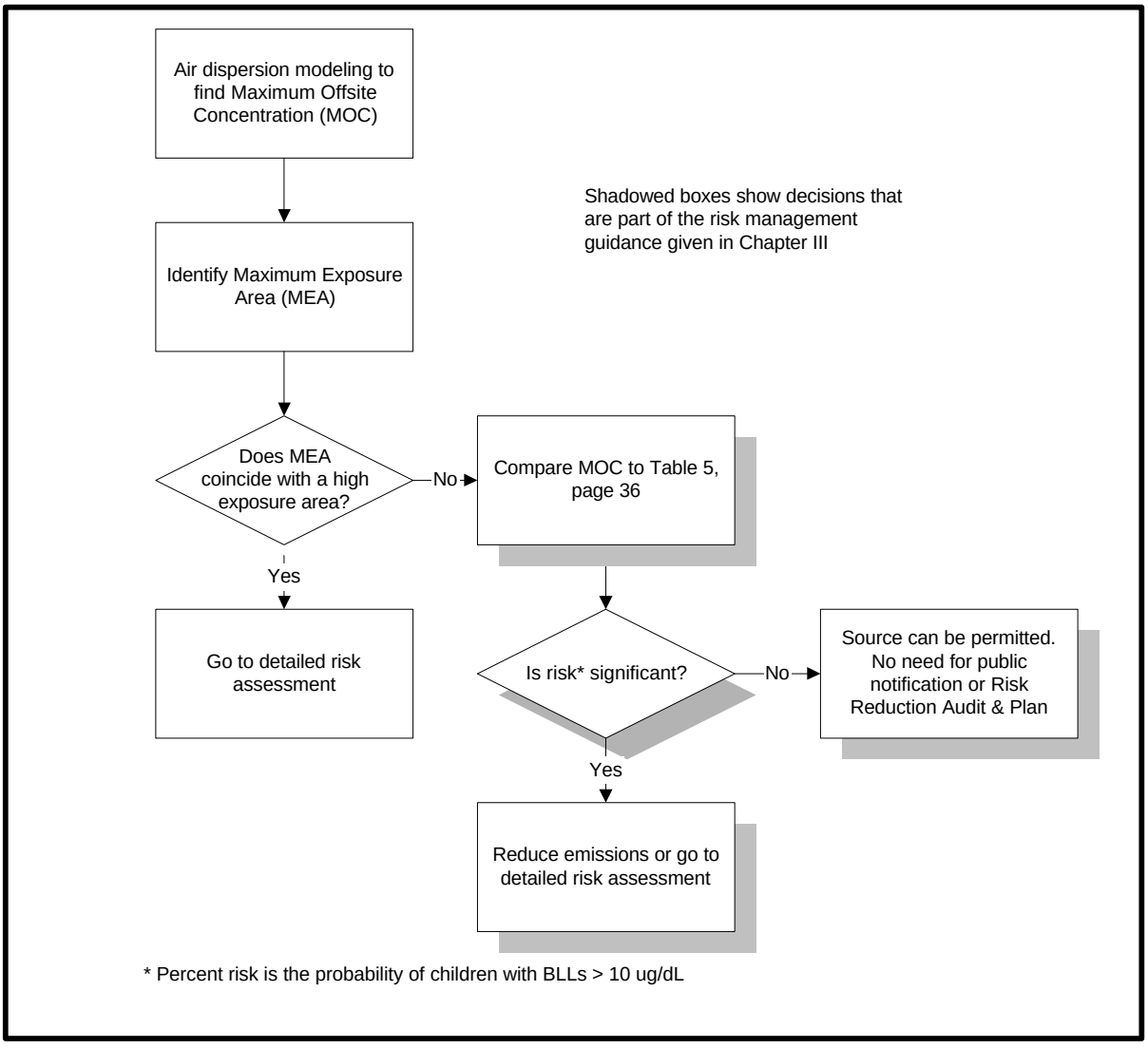
In general, we recommend that a facility discuss the risk assessment approach and reach a consensus on the approach with the district in advance. Note that the district and OEHHA must approve the risk assessments done for compliance with the Air Toxics "Hot Spots" Program.

In order to estimate health risk, you need an estimate of exposure and an estimate of potency. The estimate of exposure is based on estimates of emissions. Air dispersion modeling is then used to estimate the amount of lead in the air. The OEHHA and the SRP have approved estimates of potency for lead in the report titled, "Technical Support Document, Proposed Identification of Inorganic Lead as a Toxic Air Contaminant Part B Health Assessment," March 1997 (ARB, 1997), found on the ARB website at www.arb.ca.gov.

A. Simplified Approach for Assessing Non-Cancer Risks

In this section, we describe a simplified approach for assessing neurodevelopmental risks. This simplified approach is being proposed to provide a simple and less resource-intensive procedure for evaluating the non-cancer effects of lead exposure. This approach cannot be used in exposure areas with a high potential for existing lead exposure. However, we expect that the approach can be used for a majority of the sources in the State. Note that cancer risks must still be evaluated in accordance with procedures specified in Section D. Figure 1 is a flowchart of the simplified process discussed in this section.

Figure 1 Simplified Approach



This simplified approach is based on a conservative estimate of the air concentrations associated with the facility. These concentrations would then be compared to appropriate risk management levels presented in Chapter III, Section D. These risk management levels take into account the direct exposure from the facility and the exposure due to background concentrations in the environment. This simplified approach uses a 30-day maximum offsite concentration (MOC) to determine a maximum exposure area (MEA). The MEA is the area surrounding the MOC, equivalent to the size of a square area with side lengths of 1 kilometer. The simplified approach is conservative compared to the detailed approach for sources in an average exposure area. It is not conservative enough to be used for a source in a high exposure area. Consequently, to use this approach, a source would determine air lead concentrations and, based on the

dispersion modeled location of the MOC and census data, assess whether the MEA coincides with a high exposure census tract. If not, the source would compare the monitored or modeled air concentrations to the levels listed in Chapter III (Table 5 on page 36 for the simplified approach). A source that exceeded these levels could go on to do the more detailed assessment. In this section, we outline the steps for the simplified approach.

Step 1: Estimate the 30-Day Maximum Offsite Concentration and Location of the Maximum Exposure Area

After the lead emissions from a facility have been determined, an air quality dispersion model is used to estimate the value and location of the maximum offsite air concentration, in micrograms per cubic meter ($\mu g/m^3$), over a 30-day averaging time. The location of the maximum offsite air concentration will be used to identify the maximum exposure area (MEA). The MEA is used in Step 2 to determine whether a source can use this simplified approach for assessing non-cancer risk.

We recommend using the air dispersion modeling guidance in the OEHHA Risk Assessment Guidelines, Part IV (OEHHA, 2000). The Risk Assessment Guidelines recommend using SCREEN3 as a screening model. The SCREEN3 model uses a universal set of meteorological inputs to estimate the maximum one hour concentration. The maximum one hour concentration is then multiplied by a factor, 0.3, recommended by the U.S. EPA (U.S. EPA, 1992) to estimate the 30-day average. The ISCST3 model is recommended where a more refined analysis is desired and site-specific data are available. The ISCST3 model uses locally measured meteor-ology to estimate the one hour concentration for each hour of the year. The maximum one hour concentrations can be extracted and averaged over each consecutive 30-day period to find the highest consecutive 30-day average. Both the SCREEN3 and ISCST3 develop estimates of air concentrations and can be used to estimate the spatial distribution of concentrations. ISCST3 can create an array of receptors that can range from coarse scale (e.g. 1 kilometer spacing) to fine scale (e.g. 100 meter spacing), or consist of selected points. Currently the U.S. EPA is evaluating the ISC-PRIME and AERMOD models, and can be considered for future use upon the U.S. EPA's approval. The MEA is a 1 square kilometer area centered on the MOC and may be a square or a circular area.

Instead of using dispersion modeling to estimate ambient lead concentrations, local air monitoring data may be acceptable to characterize the air concentration for risk assessment purposes. For the district to approve monitoring data for this use, they would need to evaluate the quality of the monitoring data for this purpose. Among the factors to consider, would be the representativeness of the monitoring to exposure. This would include evaluating the frequency of sampling and analysis, seasonal and meteorological variability in ambient concentrations and the adequacy of the data to characterize the contribution from the facility. For instance, a 30-day average based on sampling every sixth day (if all samples were analyzed) is only 5 samples and may not be adequate to characterize exposure. Isolating the contribution of the facility is even

more difficult. In some cases, a direction is designated "upwind" based on the predominant wind direction and considered to be the background concentration. However this "background" concentration can include emissions from the facility if the wind direction reverses for some part of the day or night. Under these circumstances, subtracting the "upwind" concentrations would underestimate the actual exposure. Multiple monitoring locations may be required to characterize emissions over an area such as the MEA.

Step 2: Evaluate Eligibility

A source may use this simplified approach if the MEA does not overlap any census tracts with a high potential for existing exposure. A census tract with a high potential for existing exposure is defined as a census tract where the median year of construction for housing is 1960 or earlier and more than 30 percent of the population has an income less than 1.25 times the poverty level. A discussion of the basis and rationale for these criteria for defining a high exposure area can be found in Appendix C. If the source is not eligible to use the simplified approach, the detailed procedure shown in Section B should be followed.

To obtain the needed census data, you must identify the census tract number(s) that fall within the MEA. The location of specific census tract(s) can be obtained from a Census State Data Center. The location of these Census State Data Centers is presented in Appendix B.

Using the census tract number(s), you must obtain the following data from the U.S. Census Bureau website or the Census State Data Center: (1) the median age of housing for the census tract, (2) the ratio of income in 1989 to poverty level[1] (for persons for whom poverty status is determined). The ratio of income to poverty level will include nine categories ranging from less than 0.50 to 2.00 and over. To calculate the fraction of the population with an income less that 1.25 times the poverty level, you will need to sum the number of people in the 4 categories with ratios less than 1.25 and divide by the total number of people in all nine categories. Multiply this fraction by 100 to calculate the percentage you will use with the median age of housing to determine if the MEA is in a high exposure area.

You can obtain census data from the web site of the U. S. Census Bureau at http://homer.ssd.census.gov/cdrom/lookup or from one of the Census State Data Centers listed in Appendix B. Appendix B provides examples and detailed instructions for obtaining this information.

[1] The ratio of 1989 income to poverty level is given for the 1990 census data. We anticipate an equivalent statistic will be given when the 2000 census data is released.

Step 3: Compare the Air Concentrations to Risk Management Levels

This simplified approach is completed by comparing the maximum offsite air concentration determined in Step 1 to the recommended risk management levels for non-cancer health effects given in Chapter III (see Table 5, page 36), Section D, of these Guidelines. The district may choose to use different risk management levels than those recommended in Chapter III.

B. Detailed Approach for Estimating Non-Cancer Risks

In this section, we describe procedures to use for estimating non-cancer health risk from exposure to lead. This detailed approach is based on an assessment of neurodevelopmental risk. The most significant factor in assessing neurodevelopmental risk is the blood lead level (BLL) distribution in the population. Once the BLL distribution is determined, standard statistical methods can be used to calculate the percentage of the population expected to have a BLL greater than or equal to ($\geq$) a specified BLL expressed in micrograms per deciliter of blood (μg/dL).

The BLL distribution will consist of two components: (1) the baseline BLL distribution due to all sources of exposure; and (2) the exposure due to emissions from a facility. We have provided three tiers of analysis that can be used to determine baseline BLL distributions for estimating risk.

Tier I is a default approach that requires minimal site-specific information on concentrations of lead in environmental media other than air. Tier I uses two default BLL distributions, one for a high exposure scenario and one for an average exposure scenario. The default baseline BLL distribution for each of the exposure scenarios is based on a review of neighborhood and community blood lead studies. The studies and the basis for their selection as default BLL distributions are discussed in Appendix C.

Tier II develops baseline BLL distributions from site-specific estimates of lead levels in soil, dust, water, and/or food and uses the U.S. EPA Integrated Exposure Uptake Biokinetic (IEUBK) model. The IEUBK model calculates the probability of an individual exceeding a specified BLL given the site specific inputs. The aggregate of the individual risks is used to estimate the risk in the maximum exposure area. The IEUBK model is discussed in Appendix D.

Tier II involves activities that would be considered a lead hazard evaluation and would therefore be regulated under Title 17, California Code of Regulations, Division 1, Chapter 8; Accreditation, Certification, and Work Practices for Lead Based Paint and Lead Hazards[2]. This

[2] Copies of this regulation can be obtained from the Department of Hazardous Substances (DHS) Childhood Lead Poisoning Prevention Branch (CLPPB) internet address www.dhs.ca.gov/childlead, or by calling CLPPB at (510) 622-5000 or the lead related construction hotline at (800) 597-5323.

means that workers doing the sampling would need to be certified and the work would need to be carried out in compliance with work practice standards specified in Article 16.

Tier III involves actual blood lead sampling to define the baseline BLLs. In Tier III, the facility would conduct BLL testing to establish a site-specific BLL distribution.

We are recommending the neurodevelopmental risk be calculated as the probability of children in an affected exposure area having a BLL $\geq$ 10 µg/dL. This is because the Centers for Disease Control and Prevention (CDC) has identified 10 µg/dL as the BLL of concern and recommends that the prevention of BLLs $\geq$ 10 µg/dL should be the goal of all primary prevention activities. This probability would be compared to the risk management levels in Chapter III to determine whether facilities are subject to certain regulatory provisions. For some purposes, we also recommend consideration of the portion of the blood lead contributed by an individual facility.

1. Tier I - Estimating Neurodevelopmental Risk From Default Blood Lead Levels

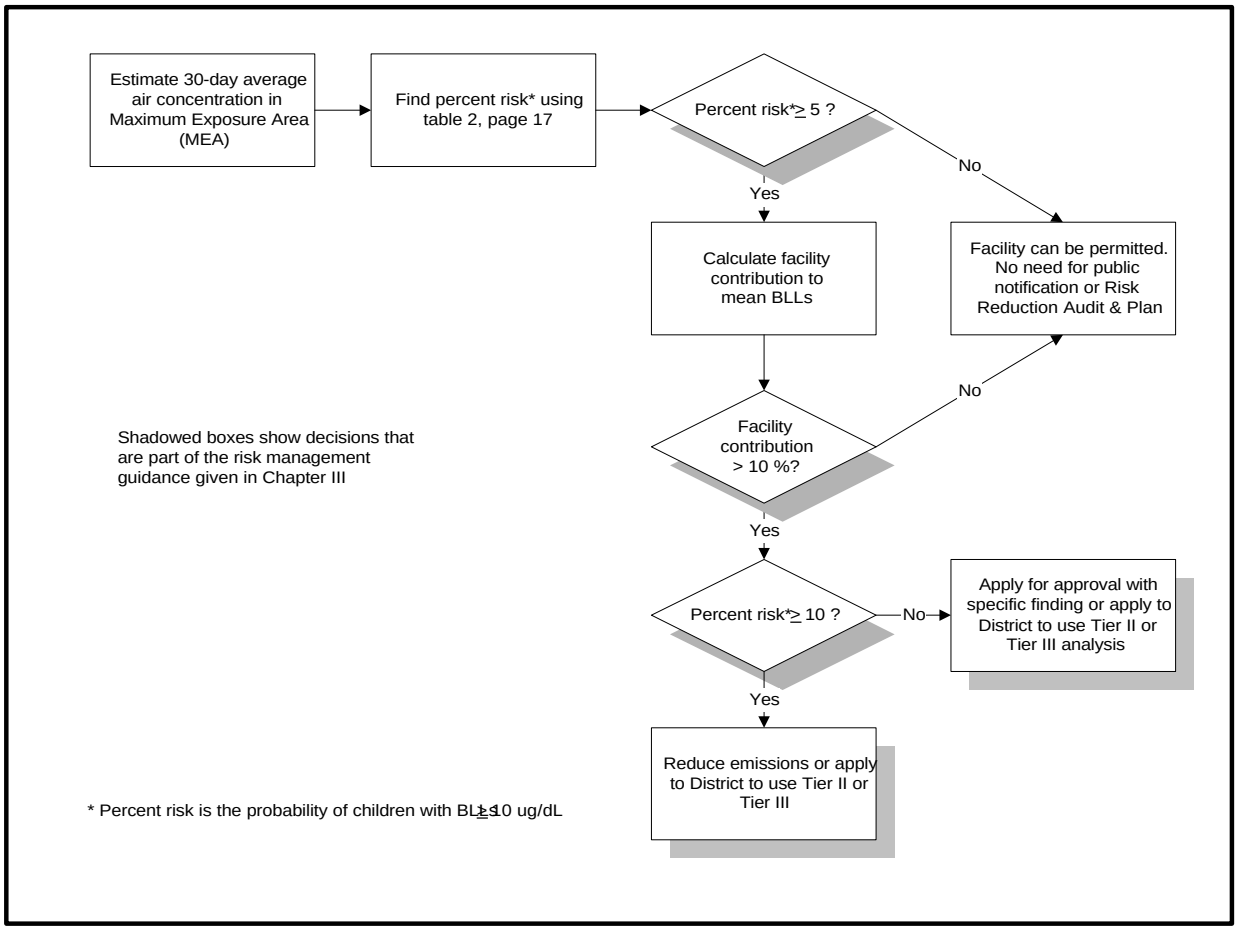
This section describes how Tier I can be used to derive an estimate of the probability that children in the maximum exposure area will have BLLs $\geq$ 10 µg/dL. In Tier I, we use default BLL distributions for two exposure scenarios: a high exposure scenario and an average exposure scenario. The high exposure scenario represents children with a higher likelihood of exposure to lead from paint. The baseline BLL distribution for the high exposure scenario has been chosen to account for this higher exposure. The average exposure scenario represents children with a more common variety of exposures.

In general, the approach involves estimating the 30-day average air concentration for the maximum exposure area, identifying the exposure scenario to determine the baseline BLL, and then estimating the probability of BLLs $\geq$ 10 µg/dL due to the facility emissions. Figure 2 is a flowchart of the steps in the detailed approach using Tier I.

Step 1: Estimate the 30-Day Air Concentration in the Maximum Exposure Area

The 30-day air concentration is calculated in the same manner outlined in Section A, Step 1. However, instead of using the maximum offsite air concentration as in Section A, Step 1,

Figure 2 Detailed Approach using Tier I Methods



the average ambient air concentration in the MEA is used.[3] If adequate monitoring data are available (see Step 1, Page 10), they may be used instead of the data obtained from the dispersion model.

The MEA is the one kilometer square area centered on the predicted point of the maxi-mum 30-day offsite air concentration of lead. Any change in the emissions or release para-meters, as might occur with the installation of air pollution control equipment, will require revised air dispersion modeling. When averaging the air concentrations, omit any air concen-trations within the boundaries of the source being evaluated.

[3] This modeling method, using an average concentration across the area of exposure, is unique to assessing the non-cancer neurodevelopmental health effects of lead and should not be used to model impacts from cancer and other non-cancer health effects. Modeling of health risks due to other toxics should be accomplished according to OEHHA Risk Assessment Guidelines, Part IV (OEHHA, 2000).

The calculation of risk for the MEA based on the average air concentration does not give a complete picture of the total potential risk because, as the lead is dispersed in the air, large numbers of people are exposed to lower concentrations. However, we believe this provides a reasonable basis for risk assessment and risk management. We make this recommendation because the air lead is affecting the BLL distribution of the whole MEA. Many factors affect the BLL distribution in children and a given level of exposure may affect individual children in different ways. Given the complexity of the exposure picture, we believe this approach most effectively describes the potential risk when effects are based on BLLs $\geq$ 10 µg/dL.

Step 2: Identify Whether a Non-Residence Exposure Correction is Appropriate

If there are residences in the MEA, the estimated 30-day average lead concentration calculated in Step 1 should be used for evaluating risk. If there are no residences in the MEA and the only exposure in the MEA is to non-residents, an adjustment may be made for reduced hours of exposure under certain conditions. For example, if the source is emitting for 24 hours a day and 7 days a week, an adjustment in air concentration may be made to account for the presence of an offsite worker for 8 hours a day, 5 days a week. In such a case, for a facility operating 24 hours a day and 7 days a week, the adjusting factor would be (8/24)*(5/7) = 0.238 if all the offsite workers are only present in the MEA for 8 hours a day and 5 days a week. This adjustment factor would be multiplied by the 30-day average air concentration estimated using dispersion modeling in Step 1 and the resulting adjusted concentration would be used in all later steps.

Step 3: Determination of the Default Baseline Blood Lead Level Distributions

We have designated criteria for identifying areas where the potential for existing expo-sure is high. These criteria are based on census data as explained in Section A, Step 2. To select the appropriate exposure scenario, you will need to obtain and use census data. You can obtain census data from the census bureau web site at http://homer.ssd.census.gov/cdrom/lookup or from one of the State census data centers listed in Appendix B.

First, identify the census tract number(s) of the MEA. The location of specific census tracts can be mapped on the census bureau's web site or can be obtained from the State Data Centers. Next, find the median age of housing for the census tract(s) and the ratio of income in 1989[4] to poverty level. The income to poverty level is displayed in the census data-base as the number of persons in each of 9 categories ranging from less than 0.50 to 2.00 and over. As explained in Section A, Step 2, you will need to calculate the percentage with incomes less than 1.25 times the poverty level within the MEA. See Appendix B for examples and detailed instructions for obtaining this information.

[4] The ratio of 1989 income to poverty level is given for the 1990 census data. We anticipate an equivalent statistic will be given when the 2000 census data is released.

In the high exposure scenario, the mean BLLs will be higher as a result of exposure to higher levels in dust and soil and typically results from the use of lead in paint. You would use the high exposure scenario if the mean age of housing is 1960, or older, and more than 30 percent of persons for whom poverty status is determined have a ratio of income to poverty level less than 1.25.

The BLL distribution for this exposure scenario is established by using two statistical parameters: (1) the geometric mean (GM); and, (2) the geometric standard deviation (GSD). The GM and GSD are necessary to calculate the percentage of the population expected to have BLLs $\geq$ 10 µg/dL. The GM and GSD are statistical terms used to describe a log-normal distribution such as blood leads. They are used with other statistical tools to estimate the fraction of blood leads that would be at or over a specific level. The GM describes the midpoint of the distribution and the GSD describes the spread. For example, in two sets of observations {1,3,3,3,4,5} and {1,2,3,3,5,6} the GM is the same but the GSD is greater for the second set because of the greater variability in the distribution.

To determine the GM and GSD for the high exposure scenario, we evaluated a number of studies of neighborhood and community BLL distributions and selected the GM and GSD from Area A in the Butte, Montana study (GM = 3.69 µg/dL, GSD = 1.84). As discussed in Appendix C, this neighborhood was selected to represent the high exposure scenario on the basis of the percentage of BLLs $\geq$ 10 µg/dL, rather than a physical or demographic resemblance to any particular neighborhood in California. We believe this percentage is representative of high exposure neighborhoods in California.

The average exposure scenario has a blood lead distribution that could be expected in an urban population exposed to average lead levels and representative of the California population as a whole. For this average exposure scenario, the GM and GSD were taken from the BLL distribution of the unexposed comparison area for the Galena, Kansas, Lead Exposure Study (GM = 3.13 µg/dL, GSD = 1.68). Use the average exposure scenario if the high exposure scenario does not apply. Table 1 shows the GM, GSD, and percentage of children with BLLs $\geq$ 10 µg/dL for each of the exposure scenarios.

Table 1 Summary of Statistics for Tier I Default Baseline Blood Lead Levels

Exposure Scenario	GM (µg/dL)	GSD	% BLLs $\geq$ 10 µg/dL
High	3.69	1.84	5.1
Average	3.13	1.68	1.2

Step 4: Estimate the Probability of Children having Blood Lead Levels ≥ 10 µg/dL due to Facility Emissions

In Step 4, we estimate the probability of children in the MEA having BLLs ≥ 10 µg/dL. This is used with the risk management levels in Chapter III, Section D, to make risk management decisions. Table 2 gives the probability for a range of predicted air concentrations for each exposure scenario.

Table 2 Children with Blood Lead Levels ≥ 10 µg/dL for Various Air Lead Concentrations at Two Exposure Scenarios

Air Lead Concentration in the MEA (30-day average) [µg/m^3]	Percent ≥ 10 µg/dL	
	High Exposure Scenario	Average Exposure Scenario
baseline*	5.1	1.2
0.02	5.4	1.4
0.06	6.1	1.7
0.10	6.8	2.2
0.20	8.9	3.4
0.25	9.8	4.1
0.50	15.9	8.9
0.75	22.4	15.4
1.0	29.1	23.0
1.5	42.5	39.0

* The baseline represents BLLs due to lead in soil, dust, water, food, and background air lead concentrations.

Table 2 was constructed using the baseline BLLs for the two exposure scenarios and the aggregate slope[5]. Because Table 2 uses the baseline BLLs as a starting point, it incorporates background exposures. The risk estimate is based on the air concentrations that would be expected due to the emissions from a specific facility. The source of the baseline BLL distributions are discussed above in Step 3 and the basis for selecting these statistics is discussed in Appendix C.

[5] The aggregate slope relates changes in air lead concentration to changes in blood lead. It is aggregate because it incorporates the lead being inhaled directly from the air and the additional lead in soil, dust, food, and water due to deposition from the air. See Appendix D for a brief discussion of the aggregate slope. "Technical Support Document, Proposed Identification of Inorganic Lead as a Toxic Air Contaminant, Part B Health Assessment" March 1997 (ARB, 1997) provides a discussion of the derivation of the aggregate slope for lead.

The risk manager can use Table 2 or the instructions in Appendix E to find the percent of children with BLLs ≥ 10 µg/dL. A reasonable approximation may be obtained by interpolating between the concentrations shown. However, the instructions in Appendix E will give a more precise estimate without the need to interpolate.

In Figure 3 below, we give an example of how to use Table 2 to find the probability of children having blood lead levels ≥ 10 µg/dL.

Figure 3 Calculating Percent Risk using Tier I Methods

Instructions	Example
1. Using an approved air dispersion model, calculate the average air lead concentration in the MEA surrounding the point of maximum impact (30-day averages).	1. The ISCST3 air dispersion model predicts an average air concentration in the MEA of 0.25 µg/m^3. This is the average for the 1 square kilometer area centered on the highest 30-day average concentration.
2. Determine the appropriate exposure scenario.	2. The MEA includes part of a census tract in which the median age of housing is 1958 and 32 percent of the population has an income less than 1.25 times the poverty level. Therefore, the correct exposure scenario is the high exposure scenario.
3. Look up the corresponding risk (percent probability of BLLs ≥ 10 µg/dL) in Table 2, or use the instructions in Appendix E.	3. The entry in Table 2 for the high exposure scenario and 0.25 µg/m^3 is 9.8 percent.

A modified version of this approach can be used to estimate the risk from operations that emit lead for fewer than 30 days. For these short term operations, the non-inhalation risk is less applicable because the air emissions will have ceased before the resulting non-inhalation exposure reaches its peak. Appendix F provides a table that is constructed using the inhalation-only slope to estimate risk from short term emission increases. To estimate risk from these short term emissions, use the instructions given above and the table in Appendix F or the instructions in Appendix E, and a slope factor of 2.0 µg/dL per µg/m^3. This slope factor was recommended by OEHHA for this purpose and is based on studies of direct inhalation in adults. These studies were reviewed by OEHHA in the health assessment which formed the basis for the identification of lead as a toxic air contaminant.

Step 5: Calculate the Facility Contribution to the Blood Lead Level

In this step, we give instructions for calculating what percentage of the average BLL in the MEA is attributable to the emissions from the facility. The facility's contribution to the average BLL is needed if the calculations show non-cancer risk is over the approvable level, or the significant risk level (see Chapter III for a discussion of risk management levels). This information will be used to determine whether a new or modified source will be required to

prepare a specific findings report as part of the permitting process or an existing source will be required to prepare a Risk Reduction Audit and Plan (RRAP).

We have recommended this step because, in the high exposure scenario, a source could completely eliminate its emissions and still be unable to reduce risk to below the significant risk level. The requirement to reduce risks to below the significant risk level is part of the Air Toxics "Hot Spots" Program. Risk management levels are discussed in Chapter III.

The contribution of the facility emissions is calculated using the GM and GSD for the BLL distribution that includes the facility emissions and the aggregate slope. Table 3 shows the geometric mean (as opposed to Table 2 which shows the percentage of the BLL distribution $\geq$ 10 µg/dL) BLL for each exposure scenario at selected air concentrations above background. It was constructed the same way as Table 2 but gives the geometric mean.

Table 3 Geometric Mean Blood Lead Levels for Various Air Lead Concentrations at Two Exposure Scenarios

Air Lead Concentration in the MEA (30-day average) [µg/m^3]	Geometric Mean BLL (µg/dL)	
	High Exposure Scenario	Average Exposure Scenario
baseline*	3.69	3.13
0.02	3.76	3.20
0.06	3.90	3.35
0.10	4.04	3.50
0.20	4.38	3.86
0.25	4.56	4.05
0.50	5.43	4.97
0.75	6.30	5.88
1.0	7.17	6.80
1.5	8.92	8.64

The calculation of facility contribution to the BLL first involves finding the arithmetic equivalent of the GM in Table 3. Because the geometric mean is a logarithmic function, you cannot add the product of an arithmetic function to it until you convert it to the arithmetic equivalent. The next step is calculating the BLL due to the air lead concentration resulting from the facility's emissions. This is the product of the air lead concentration and the aggregate slope. The last step is dividing the air lead concentration-related blood lead by the arithmetic mean. Figure 4 is an example of how to calculate facility contribution to mean BLLs using Table 3. The facility contribution is the percentage of the mean BLLs due to the air lead from the facility.

Figure 4 Calculating Facility Contribution to Mean Blood Lead Levels

Instructions	Example
1. Find the GM and GSD for the calculation. The GM is given in Table 3 for selected air concentrations. Interpolate for air concentrations between those shown. The GSD for the high exposure scenario is 1.84 and for the average exposure scenario is 1.68.	1. In the example in Figure 1, the geometric mean associated with an air lead level of 0.25 $\mu g/m^3$ is 4.56 µg/dL from Table 3 under the high exposure scenario. The GSD for the high exposure scenario is 1.84.
2. Convert the GM to an arithmetic mean: $\mu_C = \exp [\ln(\mu_G) + 1/2((\ln(\sigma_G))^2)]$ where: $\ln(\mu_G)$ is the natural log of the geometric mean, $\ln(\sigma_G)$ is the natural log of the geometric standard deviation, and, μ_C is the arithmetic mean	2. The geometric mean of 4.56 is converted to an arithmetic mean as follows: $\exp [\ln(4.56) + ½ ((\ln(1.84))^2)]$ $= \exp [1.5173 + 0.1859]$ $= \exp [1.7032]$ $= 5.49$ µg/dL
3. Calculate the contribution to the blood lead due to the air lead using the aggregate slope 4.2 $\mu g/dL/\mu g/m^3$.	3. The blood lead at an air lead concentration of 0.25 is: $0.25\ \mu g/m^3 * 4.2\ \mu g/dL/\mu g/m^3$ $= 1.05$ µg/dL
4. Divide the part contributed by the air lead from the facility by the mean blood lead and convert to a percentage.	4. The facility contribution is: $1.05 / 5.49 = 0.19 * 100 = 19$ percent

Step 6: Determine Actions Required

The actions taken on the basis of the findings of this source assessment process will depend on the purpose of the risk assessment. The risk estimate is used for one of two purposes. Under the district permitting program, the risk is used by the district to determine whether to require a new or modified source to install Toxic Best Available Control Technology (T-BACT) and to determine whether and under what conditions a source can be permitted. Under the Air Toxics Hot Spots Program, the risk assessment is compared to district defined significant risk levels to determine whether the source needs to notify the public of the potential risk, whether they are required to develop a RRAP, and under what time frame the RRAP must be implemented.

If the assessment is being done to support a permit application and the district finds that the risk is above the significant risk level, the source has three options. First, the source could request the district to permit the project based on a specific findings report, second, the source could modify the project to reduce the risk, or third, the source could apply to the district to do the assessment using Tier II or Tier III methods. If the assessment is being done for the Hot Spots program and would trigger any of the requirements, the source may still apply to the local

air district to do the assessment using Tier II or Tier III methods. Chapter III offers recommendations for significant risk levels to be used in permitting and Hot Spots determinations. These recommended levels are for guidance purposes, ultimately the districts determine the risk levels to be used in these evaluations.

2. Tier II - Estimating Neurodevelopmental Risk Using Site-Specific Lead Measurements

In Tier II, the probability of children having BLLs $\geq$ 10 µg/dL is based on site-specific measurements of lead concentrations in soil and dust, the modeled air lead concentrations, and site specific measurements or default values of lead concentrations in food and water. In this section, we give a general outline of the process for doing a Tier II assessment. This approach relies on the use of the IEUBK[6] model. The IEUBK model and the site-specific lead concentrations are used to calculate the percent of children with BLLs $\geq$ 10 µg/dL. The IEUBK model uses lead concentrations in soil, dust, air, food, and water to calculate a range of BLLs and the probability of occurrence of each (a probability distribution) for an individual child exposed to those conditions. The model can be used for a maximum exposure area by constructing a table of exposure parameters to represent each of the homes in the maximum exposure area. One set of parameters may represent more than one home. The table should contain columns for the lead concentrations and the number of children exposed to each set of concentrations. The model can then be used to estimate the risk for each group of children. The community risk is calculated by aggregating the risk for all the children. For detailed instructions on using the IEUBK model, you will need to consult the IEUBK Guidance Manual.

When used with existing lead concentrations, the IEUBK model calculates current risk. It can be used to predict risk due to increased emissions through the use of supplemental equations as described in Step 4 on pages 25 and 26. The OEHHA provided values to be used in the supplemental equations to estimate the increased soil and dust lead levels due to the increased air lead. See Appendix D for a more detailed discussion of the IEUBK model.

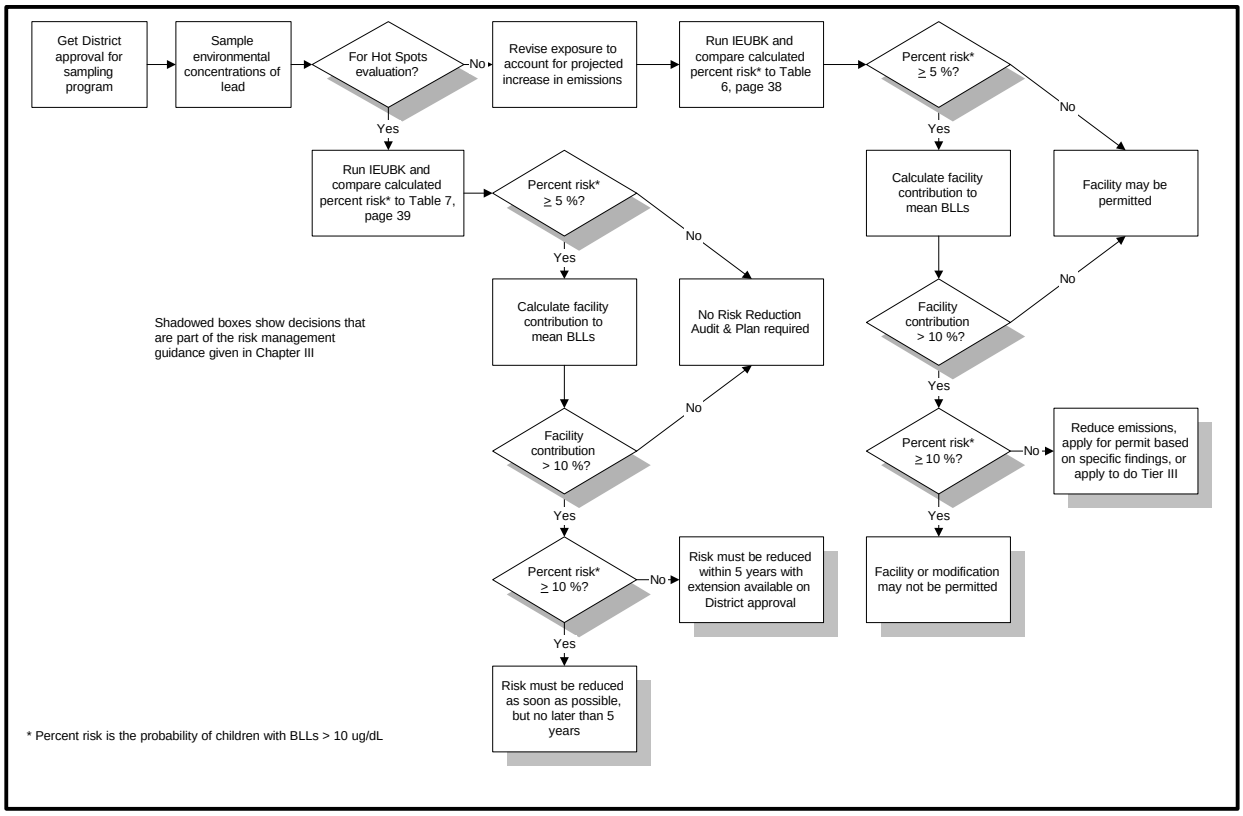
The IEUBK is designed for estimating risk to children. As of the release of this document, the ARB staff has not identified an approvable alternative blood lead model. If there are no residences in the MEA, the source has three options. First, the source may propose to use the IEUBK model to evaluate risk consistent with these guidelines. In this case, the source must propose a soil and dust sampling plan similar to that required when using the model for children. Second, a source may elect to conduct a Tier III analysis. Third, a source may propose the use of an alternative blood model. The district may approve the use of an alternative model with the

[6] The IEUBK model version 0.99 and the Guidance Manual are available for purchase from the National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA, 22161. Refer to PB 93-963510. The NTIS also takes phone orders at (703) 487-4650 or (800) 553-6847 from 8:30 to 5:30 EST weekdays, by e-mail at order@ntis.fedworld.gov, or by fax at (703) 321-8547.

concurrence of ARB. The ARB will evaluate the use of an alternative approach or model on a site specific basis within 60 days of the date the district requests the evaluation. The ARB will evaluate an alternative approach or model for general use within 180 days of the date the district requests the evaluation.

The use of the IEUBK to calculate the baseline percentage of BLLs ≥ 10 µg/dL will require a sampling plan designed to adequately characterize the exposure to children in the maximum exposure area from all sources of lead in the environment. The air concentration to use in calculating the baseline BLL will depend on whether you are calculating the risk due to a new or an existing source. Assessment of a new source will use the background air lead levels for the baseline while assessment of an existing source will use background plus source-specific air lead concentrations. Once the baseline blood lead distribution is found using the IEUBK, the increased risk from projected increases in emissions can be calculated. Figure 5 is a flowchart of the steps to be followed as part of Tier II.

Figure 5 Detailed Approach Using Tier II Methods



When soil and/or dust will be sampled for lead concentrations in homes to characterize exposure in a maximum exposure area near a facility, the facility will need to contact the local Public Health Officer and the California Department of Health Services Childhood Lead Poisoning Prevention Branch (CLPPB) in advance to inform them of the intent and scope of the sampling. To assist the facility in contacting the CLPPB, a form is provided in Appendix K. The facility should also consult with the local air district on its plans to conduct sampling. The U.S. EPA, the Department of Housing and Urban Development (HUD), and American Standards and Testing Methods (ASTM) all have published guidance on soil and dust sampling for lead concentrations[7]. An individual conducting sampling for lead in soil and dust must be certified by the California Department of Health Services as a Lead Inspector/Assessor and must comply fully with California regulations as set forth in Title 17, California Code of Regulations, Division 1, Chapter 8; Accreditation, Certification, and Work Practices for Lead Based Paint and Lead Hazards.

Step 1: Estimate the 30-Day Air Concentration in the Maximum Exposure Area

The 30-day average is calculated as in Section A Step 1 using an air dispersion model. As in Tier I, use the air concentration in the area in which the maximum predicted air lead concentration occurs. Because the air lead concentration will vary over the area, a graphical depiction of the air concentrations in the affected area will be needed to develop the exposure table.

Step 2: Identify the Exposure Conditions for the Population in the Maximum Exposure Area

The exposed population would be the same as that identified for Step 2 of Section II B. For Tier II, however, additional information about the number of children in the affected area will be used in the exposure table. If there are no residences in the MEA, the source may pro-pose the use of an alternative model. The district could approve the use of an alternative model, with ARB's concurrence.

We expect that air, soil, and dust lead concentrations will vary over the area. Therefore, a graphical depiction of the air lead and a soil and dust sampling plan designed to adequately depict

[7] Guidance available to assist sources in developing a sampling plan include the following: EPA 747/R-95-001, Residential Sampling for Lead: Protocols for Dust and Soil Sampling, Final Report, March 1995; HUD Guidelines for the Evaluation and Control of Lead Based Paint Hazards in Housing, Chapter 7; ASTM E 1727 Standard Practice for Field Collection of Soil Samples for Lead Determination by Atomic Spectrometry Techniques; ASTM E 1728 Standard Practice for Field Collection of Settled Dust Samples Using Wipe Sampling Methods for Lead Determination by Atomic Spectrometry Techniques; and Provisional Standard (PS) 46 Practice for the Collection of Surface Dust by Air Sampling Pump Vacuum Technique for Subsequent Lead Determination.

the exposure potential in the area should be developed. The results of the soil and dust sampling and predicted air concentrations will be entered into an exposure table. Each line in such a table is used in the model to represent exposure to some portion of the children in the maximum exposure area.

An accurate estimate of the dispersion of the BLLs in the maximum exposure area cannot be obtained by using the area average for the air, soil, and dust levels. If site-specific lead levels for food and water can not be obtained, area averages and/or defaults given for the IEUBK by the U.S. EPA can be used.

Step 3: Determine the Existing Percent of Blood Lead Levels ≥ 10 µg/dL Using Site-Specific Data with the Integrated Exposure Uptake Biokinetic Model

Instead of using default BLL distributions as in Tier I, a facility operator can develop a baseline BLL distribution from site-specific estimates of lead concentrations in soil, dust, air, food, and water using the IEUBK model.

The soil and dust sampling should be representative of the levels to which children in the MEA are exposed. Representative sampling can be used for homes with significant similarities. Use the sampling results and the air quality modeling to construct a table that represents the various environmental concentrations to which the children of the community are or would be exposed and show the number of children exposed to each set of concentrations.

Using the IEUBK and the exposure table, calculate the probability of a BLL ≥ 10 µg/dL for each child. The model will give a set of probable BLLs and the probability of each (called a probability density) for each of the sets of environmental conditions in the exposure table. It can be used to calculate a distribution of possible BLLs for a group of children exposed to the same concentrations even if they don't live in the same residence. This distribution of possible blood lead concentrations depicted by the IEUBK model represents the effect of inter-individual variability. This is important because it illustrates the effect of behavior and physiology in predicting blood lead levels. The model uses a GSD of 1.6 to represent the inter-individual variability which is variability not related to differences in the concentrations in soil, dust, air, food, and water. To estimate the risk in the MEA, the model would have to be run for each set of environmental concentrations in the exposure table and the resulting risk for each child aggregated.

For a new source, the air lead concentration used in the IEUBK model to calculate baseline BLLs should be the background air lead concentration for the air basin. For an existing source, the air lead level to be used in the IEUBK model should be the sum of the modeled air lead concentrations from the current source emissions and the background air lead concentrations for the air basin. This is because the air lead concentrations derived in Step 1 are exclusively the lead concentrations due to emissions from the source. If there will be no increase in emissions, as

would be the case for an existing source doing a risk assessment for the Hot Spots program, the baseline risk is compared with the risk management levels. Depending on the level of risk found and the district designated significant risk level, the source might need to complete Step 5.

Step 4: Estimate the Probability of Blood Lead Levels ≥ 10 µg/dL due to New or Increased Emissions

In this step, we discuss the process for estimating risk when emissions are expected to increase as a result of a new source or modifications to an existing source. To estimate the projected percent of BLLs ≥ 10 µg/dL at the increased emission rate from a new or modified source, you can run the IEUBK model with an updated exposure table. Use the background air lead concentrations plus the air lead concentrations estimated for the facility including the projected increase. Calculate the projected increase in the soil lead and dust lead using the supplemental equations. Use the same inputs for food and water as in Step 3. Then run the IEUBK model with the new inputs, and aggregate the result.

The supplemental equations are given below. They were developed for the IEUBK by the U.S. EPA and are discussed in the guidance manual for the IEUBK. The values to be used in the equations are given in Table 4. These values were developed by the OEHHA and are dis-cussed in Section 4 of the Technical Support Document, Proposed Identification of Inorganic Lead as a Toxic Air Contaminant, Part B Health Assessment (ARB, 1997). This document is available on the ARB website at www.arb.ca.gov.

Table 4 Parameters for Use in the Supplemental Equations S1 and S2

Parameter	Column 1 urban mix of sources	Column 2 large point source
a_1	510	206
c_1	844	551

To predict soil lead concentrations when air lead concentrations increase, use Equation S1.

Equation S1: $S = a_0 + a_1 * A$

Where:

S is the increased soil lead concentration to be used in the IEUBK model;

a_0 is the initial site-specific soil lead concentration measured for the IEUBK analysis;

a_1 is taken from Table 4 (column 1 values are for areas with typical urban sources and column 2 are for areas more strongly impacted by a single source); and,

A is the air lead concentration associated with the new facility emissions.

To predict dust lead concentrations when air lead concentrations increase, use Equation S2.

Equation S2: $D = c_0 + c_1 * A$

Where:

D is the increased dust lead concentration to be used in the IEUBK model;

c_0 is the initial site-specific dust lead concentration measured for the IEUBK analysis;

c_1 is taken from Table 4 (column 1 values are for areas with typical urban sources and column 2 for areas more strongly impacted by a single source); and,

A is the air lead concentration associated with the new facility emissions.

Step 5: Calculate the Facility Contribution to the Blood Lead Levels

If you are using the Tier II approach to estimate risk for an existing facility, the simplest way to calculate the contribution of the facility to the geometric mean blood lead levels for the maximum exposure area is to use the aggregate slope as illustrated in Figure 4 on page 20.

Another way to calculate facility contribution is to use the IEUBK model. However, using the IEUBK model to calculate the facility contribution is more complicated. It is more complicated because the measured concentrations in dust and soil already include the contribution from existing air emissions from the facility. To use the IEUBK model, you would have to predict what the soil and dust concentrations would be in the absence of emissions from the facility. This could be done with the supplemental equations. You would then run the IEUBK model again as you did for Step 3, using the background air lead and the predicted soil and dust levels. The difference in means would be the exposure due to the facility's emissions. This would then be divided by the mean calculated in Step 4 and multiplied by 100 to find the percentage of the mean BLL that was due to the facility. The IEUBK has a feature that attributes the risk to the various media. However, the value this feature attributes to air is only the risk due to inhalation and, therefore, is not the equivalent of the instructions in this paragraph and should not be used with the risk manage-ment levels in Chapter III.

Step 6: Determine Actions Required

The actions the source may choose to take on the basis of the results of this assessment will depend on the purpose of the risk assessment. Under the district permitting program, the risk is used by the district to determine whether to require a new or modified source to install toxic Best Available Control Technology and to determine whether and under what conditions a source can be permitted. If the assessment is being done to support a permit application and the risk is found to be significant, the source has three options. One would be to request the district to permit the project on the basis of a specific findings report. Another would be to modify the project to reduce the risk. A third would be to do the risk assessment using Tier III.

Under the Air Toxics Hot Spots Program, the risk assessment is compared to local air district-defined risk levels to determine whether the source needs to notify the public of the potential risk, whether they are required to develop a RRAP, and under what time frame the RRAP must be implemented. If the assessment for Hot Spots indicates the source must take action to notify the public or reduce the risk, the source can request the district to allow them to assess the risk using Tier III. In Chapter III, we make recommendations for risk levels to be used in permitting and Hot Spots determinations. However the district has the statutory authority to set risk levels for these purposes.

3. Tier III - Estimating Neurodevelopmental Risk using Actual Blood Lead Levels

In this section, we describe an approach to calculating neurodevelopmental risk using the results of blood lead testing in the MEA. If a facility operator feels that the Tiers I and II options do not accurately portray the actual BLLs in the maximum exposure area, the operator can request that the district allow blood lead testing to establish site-specific baseline GM BLL and GSD to determine the number of children with BLLs of concern. Because of the complexity and expense associated with this approach, we expect this approach to be rarely used. This option involves the collection of confidential medical information and involves human subjects. Therefore, the facility operator will need to contract with a university or public health agency to carry out the study. The district, the Public Health Officer, and the CLPPB will need to be included in all aspects of the planning and execution of the study. In addition, the district will have to review and approve the study design and the contractor. Figure 6 is a flowchart of the steps to be followed in a Tier III evaluation.

Step 1: Estimate the 30-Day Air Concentration in the Maximum Exposure Area

The 30-day average is calculated as in Section A Step 1 using an air dispersion model. As in Tier I, use the air concentrations in the area in which the maximum offsite air concentration is predicted to occur. For an existing source, the main use of the modeling is to identify the exposed population. For a new source, the concentrations are needed to predict how the existing BLL distribution will be changed. Any change in the emissions or release parameters will require revised air dispersion modeling.

Step 2: Identify the Exposed Population

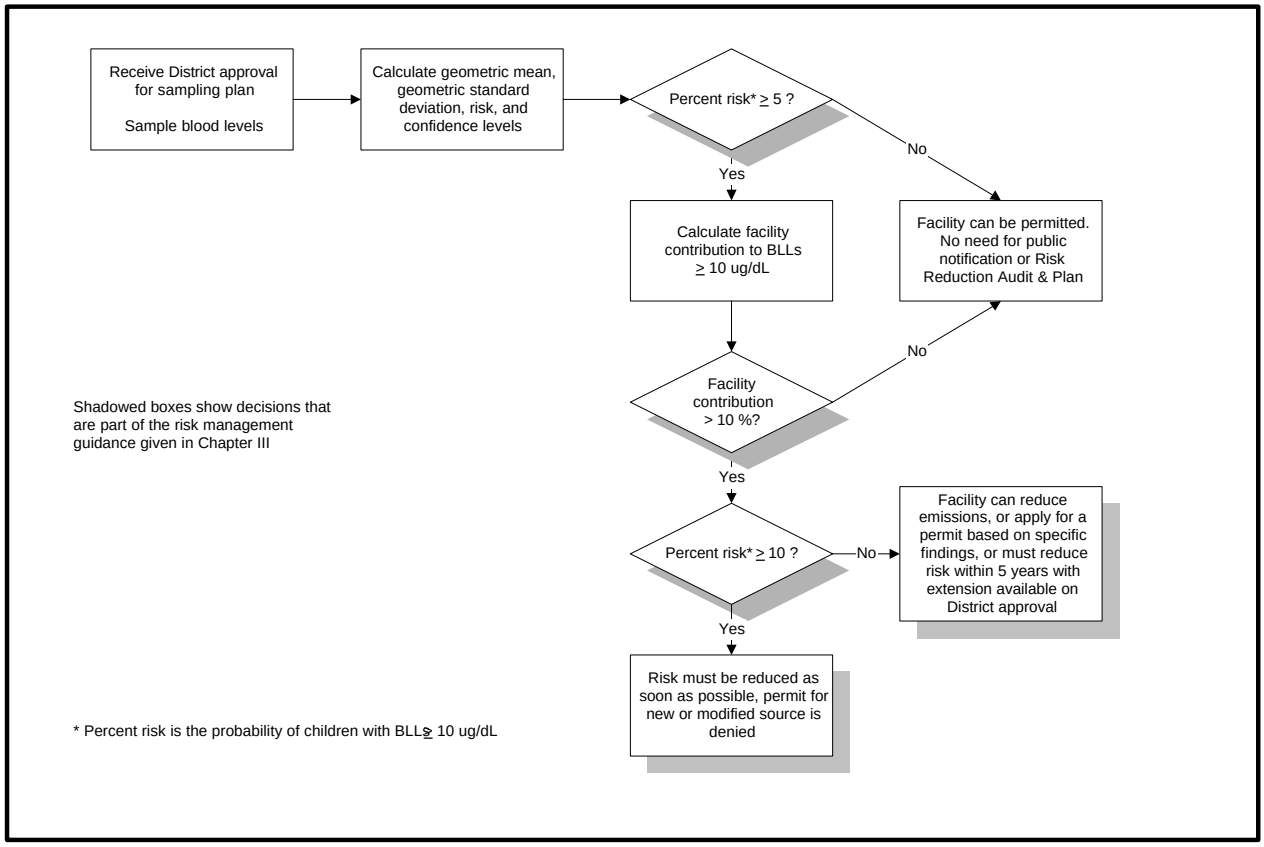
The exposed population would be the same as that identified for Step 2 of Section B.

Step 3: Determine the Baseline Blood Lead Distribution Using Blood Lead Sampling

Blood lead sampling needs to be done in a way that accurately represents the area and is likely to include the most exposed persons. Because the effect of lead exposure may differ by

ethnicity and income, it is important for the sampling plan to ensure that all segments of the exposed population are represented.

Figure 6 Detailed Approach Using Tier III Methods



Determination of the number of children to be sampled is dependent on the characteristics of the distribution, the statistics needed, and the desired levels of precision and accuracy. To eval-uate neurodevelopmental effects, both the GM and the percent of children with BLLs ≥ 10 µg/dL are characterized by determining the sample size for each statistic and using the greater of the two.

Appendix G contains a discussion of how precision and accuracy relate to the number of children to be sampled. Appendix G also contains tables and related formulae for determining the number of children that would need to be tested to achieve a desired level of precision and accuracy. These data are provided to assist the district in evaluating any proposed blood lead sampling plans. Appendix G contains tables for a large population and equations that can be used to relate those tables to smaller populations. We are not recommending that a specific precision and accuracy be required. However, we are recommending that the precision and accuracy attained in a given study be documented in the report to the district and be reported to the public, if public

notification is triggered. Failure to find children with BLLs of concern in a given blood sampling program does not necessarily mean that there is no risk. It may reflect poor precision or accuracy, the effect of chance, or sampling bias.

Step 4: Estimate the Probability of Blood Lead Levels ≥ 10 µg/dL due to Facility Emissions

From the sampling data, calculate a GM and GSD. The GM and GSD are used as shown in Appendix E to calculate the probability of BLLs ≥ 10 µg/dL. The process involves calculating the Z-score, and finding the associated percentage on a table of Z-scores. The percentage found on the table of Z-scores is subtracted from 1 if the mean is less than 10 µg/dL.

For a facility using Tier III to characterize risk from an existing facility for compliance with the Hot Spots Program, the calculated probability of BLLs ≥ 10 µg/dL will be the facility risk. For a facility seeking a permit to modify or a new facility, it will be the baseline risk and the increased risk due to the projected increase in emissions will need to be calculated and added to the baseline.

The site-specific baseline blood lead distribution calculated in Step 3 forms the baseline for a facility seeking a permit to modify an existing facility or construct a new facility. The additional risk due to increased emissions can be calculated by applying the blood lead/air lead slope calcu-lated for children (4.2 µg/dL blood lead per µg/m^3 air lead). Because the slope is a linear function, you must first convert the geometric mean to an arithmetic value to add the product of the slope and increased air lead. Appendix E gives the instructions for making this calculation. Using these instructions, you can calculate the change in the geometric mean blood lead and additional per-centage risk of children having a blood lead level ≥ 10 µg/dL as a result of the projected increase in emissions.

Step 5: Calculate the Facility Contribution to the Blood Lead Levels

The calculation of facility contribution would be done as shown in Figure 4 (Tier I, Step 5) using the aggregate slope.

Step 6: Determine Actions Required

Sources that have done Tier II and Tier III analyses, have fewer options. The available options will depend on the purpose of the risk assessment. Under the district permitting program, the risk is used by the district to determine whether to require a new or modified source to install T-BACT and to determine whether and under what conditions a source can be permitted. If a risk assessment is done to support a permit and finds the source will result in significant risks, the source has two remaining options. One would be to request the district to permit the source on the basis of specific findings. The other would be to change the proposed project to reduce the risk. Under the Air Toxics Hot Spots Program, the risk assessment is compared to district defined risk levels to

determine whether the source needs to notify the public of the potential risk, whether they are required to develop a RRAP, and under what time frame the RRAP must be implemented. If an assessment for the Hot Spots Program shows an action is required and all the Tiers have been used, the only option left is to comply. In Chapter III, we make recommendations for risk levels to be used in permitting and Hot Spots determinations. However, the district has the authority to designate the risk levels for use in permitting and Hot Spots.

C. Cancer Effects Analysis

In this section, we briefly discuss procedures for cancer risk analysis. The cancer risk analysis produces an estimate of the maximum offsite cancer risk or the maximum individual cancer risk whichever the district requires. Cancer risk from all carcinogens emitted are summed to estimate the facility cancer risk. For further information, see the OEHHA Risk Assessment Guidelines, Part II (OEHHA, 1999).

Step 1: Estimate the Maximum Annual Average Ambient Concentration

Use an approved atmospheric dispersion model with facility-specific emission rate and release parameters to estimate the maximum annual average offsite air concentration at an existing receptor as directed by the district. See the CAPCOA Risk Assessment Guidelines for modeling instructions.

Depending on whether a source is a new source or an existing source seeking a permit to modify, and the levels of risk found, a source may need to evaluate the risk before and after application of control technology, and the project and overall source risk. Any change in the emissions or release parameters will require revised air dispersion modeling.

Step 2: Estimate the Inhalation and Non-Inhalation Cancer Risk

To estimate inhalation cancer risk, multiply the unit risk factor by the maximum annual average air concentration calculated in Step 1. The unit risk factor recommended by the OEHHA for lead is 1.2×10^{-5} per $\mu g/m^3$. For some substances, including lead, the inhalation risk is only a part of the risk. Additional risk from the emissions to the air occur when airborne lead gets in or on household surfaces, water, and food. The contribution of these secondary routes of exposure are evaluated by using a dispersion modeling post-processing model such as the ARB Health Risk Assessment (HRA) model to calculate non-inhalation risk. The HRA model can be down-loaded from the ARB web site, www.arb.ca.gov. For an order form to purchase the HRA users manual with an electronic version of the HRA model, contact the ARB Emission Assessment Branch office at (916) 323-4327.

The inhalation and non-inhalation risks are added together to derive the cancer risk from lead. This is then added to the risk from all other potential carcinogens emitted from the source to derive the total cancer risk due to the source.

Step 3: Determine Actions Required

If a detailed risk assessment is done according to the risk assessment guidelines, the only options available are to modify the project or comply. The district determines whether to require a new or modified source to install T-BACT and whether and under what conditions a source can be permitted. Under the Air Toxics Hot Spots Program, the district defines risk levels to determine whether the source needs to notify the public of the potential risk, whether they are required to develop a RRAP, and under what time frame the RRAP must be implemented. In Chapter III, we make recommendations for risk levels to be used in permitting and Hot Spots determinations.

III. Risk Management Guidelines

This Chapter presents the staff's suggested approach for evaluating new, modified, and existing lead emission sources. In this Chapter, we discuss applicability, define key terms, discuss the approach for permitting new and modified sources, and summarize additional requirements. The suggested approach frequently presents only one method for handling each element of the proposal. We acknowledge that alternative approaches may be acceptable for a particular district.

The districts have permitting authority for stationary sources and are also responsible for setting public notification and risk reduction levels for the Hot Spots Program. The districts evaluate applications for permits to construct new sources or to modify existing sources. In this evaluation, the district considers the effect of the proposed changes on the overall air quality in its jurisdiction and the potential effect on public health. In reviewing applications for permits to construct new or modified sources, the district must decide whether the new or modified source can be permitted and when to require the source to install Toxic Best Available Control Technology (T-BACT). We have designed these guidelines to be consistent with the Risk Management Guidelines for New and Modified Sources of Toxic Air Contaminants (ARB, 1993).

With regard to existing sources that are evaluated under the Hot Spots Program, districts must set the risk levels at which public notification and risk reduction audits and plans are required, and determine the timing of the required risk reductions.

We examined a number of data sources to guide our risk management recommendations and selection of default values for assessment procedures. We evaluated several strategies and reviewed numerous blood lead studies. We also looked at levels used by other agencies and for similar types of chemicals or similar types of health effects. These considerations and studies are discussed in detail in Appendices C and H.

A. Applicability

These guidelines are intended to apply to any new, modified, or existing stationary source that is required to obtain a permit or comply with the Hot Spots Program pursuant to district regulations.

B. Key Terms

In this section, we define key terms used in this Chapter.

Facility Contribution

The facility contribution is the percentage of the average (geometric mean) BLL in the maximum exposure area which is a result of the lead emissions from the facility.

Maximum Excess Cancer Risk (MECR)

The maximum excess cancer risk (MECR) is an estimate of the highest increased cancer risk resulting from a project's or source's emissions of carcinogens including lead. The MECR is the maximum individual offsite cancer risk. See the OEHHA Risk Assessment Guidelines, Part IV (OEHHA, 2000) for details.

Maximum Exposure Area

The area within 1 square kilometer of the maximum offsite concentration.

Maximum Offsite Concentration

The highest air concentration predicted by the air dispersion model at an offsite location or at an offsite receptor depending on district requirements. The district could allow the use of monitoring data if that data were of sufficient quality.

Modification

A modification is either:

(1) the addition of any new permit unit at an existing source; or
(2) any physical change in, change in method of operation of, or addition to an existing permit unit that requires an application for a permit to construct and/or operate. Routine maintenance and/or repair shall not be considered a physical change. A change in the method of operation of equipment, unless previously limited by an enforceable permit condition, shall not include:

a) an increase in the production rate, unless such increases will cause the maximum design capacity to be exceeded; or
b) an increase in the hours of operation; or
c) a change in ownership of a source.

Permit Unit

A permit unit is any article, machine, piece of equipment, or other contrivance, or combination thereof which may cause or control the release of lead and which requires a written permit.

Project

A project is any permit unit or grouping of permit units or other activities which emit lead, located on one or more contiguous properties within a district, including properties that are separated solely by a public road or other public right-of-way, and are owned or operated by the same person (or by persons under common control).

Specific Findings Report

Specific findings are made by the district when permitting a source that imposes a risk above specified levels. The source may submit data to support the district's findings. The specific findings are made public in a report containing the reasons that support the decision to grant or deny a permit.

Stationary Source or Source

For the purposes of these Guidelines, a stationary source or source refers to all permit units or activities which emit lead located on one or more contiguous properties within a district, including properties that are separated solely by a public road or other public right-of-way, and are owned or operated by the same person (or by persons under common control).

Toxic Best Available Control Technology (T-BACT)

T-BACT means the most effective emissions limitation or control technique which:

(1) has been achieved in practice for such permit unit category or class of source; or
(2) is any other emissions limitation or control technique, which includes process and equipment changes of basic and control equipment, found by the Executive Officer or Air Pollution Control Officer to be technologically feasible for such class or category of sources, or for a specific source.

Although the definition of T-BACT does not explicitly state that cost is considered when determining T-BACT, in practice we recognize that T-BACT decisions implicitly take cost into consideration.

C. Definition of Risk Management Levels

In the permitting process, the districts make decisions about the need for control technology and whether new sources or modifications to existing sources can be permitted. For this purpose, the district identifies the following risk levels:

1) a T-BACT trigger level. This is the risk level at which the district would require a source to install T-BACT on the new source or the new equipment at an existing source;
2) an approvable level. Below this level, the district could approve a new source or modification to an existing source without a Specific Findings Report; and
3) a permit denial level. At a risk equal to or above this level, the district would deny a permit.

The district may require existing sources which are subject to the Hot Spots Program to do a risk assessment. Depending on the results of that risk assessment, the source may have to notify the public of the risk assessment results and may be required to reduce the risk. The districts are required to define the following risk management levels for the Hot Spots Program:

1) a notification level. This is the risk level at which facilities need to notify the exposed population (this could be the same as the significant risk level);
2) a significant risk level. At this level, facilities would be required to implement a risk reduction audit and plan. The risk reduction audit and plan must show how the facility will reduce the risks to below this level; and
3) an unreasonable risk level. Facilities with risks equal to or above this level must reduce their risks within five years or less.

D. Risk Management Levels for the Simplified Approach for Assessing Non-Cancer Risks

In this section, we present a simplified risk management approach for use by districts and sources in determining non-cancer risks. It is based on the simplified approach presented in Chapter II, Section A. For permitting new and modified sources, we provide recommendations for a T-BACT trigger level, an approvable level, and a permit denial level. For the Hot Spots Program, we make recommendations for public notification, significant risk, and unreasonable risk levels, shown in Table 5. In Appendix H, we discuss the basis for these recommended risk management levels. As explained in Chapter II, this approach would not apply to sources where the maximum exposure area had a high potential for existing exposure. Children in these areas need a greater level of protection because of the high background exposure potential.

Table 5 Recommended Risk Management Levels Using the Simplified Approach (Chapter II. A.) for Assessing Non-Cancer Risks

Lead Permitting Levels		**Hot Spots Program Levels**	
T-BACT trigger level	Emissions $\geq$ 1 pound per month	Notification level[1]	Maximum offsite air concentration $\geq$ 0.30 $\mu g/m^3$
Approvable level[1]	Maximum offsite air concentration $\leq$ 0.30 $\mu g/m^3$	Significant risk level[1]	Maximum offsite air concentration $\geq$ 0.30 $\mu g/m^3$
Permit denial level[1]	Maximum offsite air concentration $\geq$ 0.55 $\mu g/m^3$	Unreasonable risk level[1]	Maximum offsite air concentration $\geq$ 0.55 $\mu g/m^3$

[1] *Not applicable to high exposure areas.*

We are recommending T-BACT be required for any new source that will emit more than 1 pound of lead per month and any existing source where a modification will result in an increase in emissions of 1 pound per month. This recommendation is based on consideration of current ambient lead levels and both cancer and non-cancer risk. At this emission level, we estimate that neurodevelopmental risks would not be increased by more than 1 percent and cancer risk would be less than 1 in a million.

At an air concentration greater than or equal (≥) to an approvable level, but below the permit denial level, a source could be permitted on the basis of a specific findings report. For the simplified approach, we are recommending an air concentration from the facility of less than or equal to (≤) 0.30 μg/m^3 as the approvable level. We are recommending a permit denial level for the simplified approach at ≥ 0.55 μg/m^3. At 0.30 μg/m^3, we estimate there will be less than a 5 percent probability of BLLs exceeding 10 μg/dL in children who do not live in a high exposure area. At 0.55 μg/m^3, we estimate there will be no more than a 10 percent probability of BLLs exceeding 10 μg/dL except in a high exposure area. These air concentrations are the 30-day average maximum offsite air concentrations due to the emissions from the facility. These air lead concentrations were chosen by examining the data and evidence detailed in Appendix H and selecting levels that did not represent an unacceptable public health risk.

In the Hot Spots Program, for the simplified approach we recommend the public notification level and the significant risk level both be set at an air concentration of 0.30 μg/m^3 and the unreasonable risk level be set at 0.55 μg/m^3.

E. Risk Management Levels for Permitting New and Modified Sources Using the Detailed Approaches (Chapter II. B.)

In this section, we present our recommendations of levels for districts to use in permitting new and modified sources. In developing these recommendations, we considered two types of information. We considered the regulatory precedents set by other agencies and for other pollutants. We also considered the risks to communities from all sources of lead exposure. See Appendix H for a discussion of the basis and rationale for these risk management recommendations.

1. Level of Emission Control Required

For non-cancer or cancer effects of lead, these Guidelines recommend levels that would trigger the requirement for further control. For lead, we are recommending a T-BACT trigger based on an emission rate rather than risk levels. We have chosen this approach in recognition of the data needs and complexity of the risk assessment process.

We are recommending T-BACT be required for any new source that will emit more than 1 pound of lead per month and any existing sources where a modification will result in an increase of emissions of 1 pound per month. This recommendation is based on consideration of current ambient lead levels and both non-cancer and cancer risk. At this emission level, we estimate that neurodevelopmental risks would not be increased by more than 1 percent and cancer risk would

be less than 1 in a million. This is consistent with the ARB Risk Management Guidelines (ARB, 1993) and the Department of Toxic Substances Control's (DTSC) "point of departure"[1] for risk management.

2. Risk Following Application of Control

The requirement for T-BACT is based on new or increased emissions (i.e, the project risk.) while the permitting decisions are based on the source risk. If T-BACT is required, the non-cancer or cancer health risks following application of T-BACT to the project must be recalculated using the reduced emissions. This is the risk due to the facility as a whole. If the project is a new facility, the project risk is the same as the source risk.

3. Consideration of Source Risk

The following is a description of the way the recommended levels would be applied for districts that adopt the recommended levels listed in Table 6. If the source risk for all potential health effects is below the approvable level as defined by the district, the district my permit the facility. If the source risk is above the denial level as defined by the district, the district will not issue the permit. If the source risk is above the approvable level and below the denial level for neurodevelopmental risk, and the percent contribution of the facility is below the significant level, the district may grant the permit. Otherwise, the district may grant the permit on the basis of a specific findings report. See Appendix I for details on how to prepare a Specific Findings Report. See Table 6 for the recommended approvable levels for new and modified sources.

Table 6 Recommended Permitting Levels for New and Modified Sources

	Neurodevelopmental Effects	**Cancer**
T-BACT trigger level	emissions ≥ 1 pound per month.	emissions ≥ 1 pound per month.
Approvable level	overall source risk: 5% probability of children ages 0-7 years with BLLs ≥ 10 µg/dL or facility percent contribution to BLLs is ≤ 10% (when the probability is > 5% but < 10%).	maximum excess risk due to emissions from the facility < 10/million among all residents and workers (district may permit sources between 10 and 100 per million based on specific findings)
Permit denial level	overall source risk: ≥10% probability of children ages 0-7 years with BLLs ≥ 10 µg/dL	maximum excess risk due to emissions from the facility ≥ 100/million among all residents and workers

[1] DTSC's "point of departure" is generally regarded as a level below which no action need be taken. At levels above this, the agency may consider other factors such as land use, technical feasibility, or cost in determining appropriate risk management actions.

For the detailed risk management approach, we are recommending a 5 percent or less probability of BLLs ≥ 10 µg/dL for neurodevelopmental risk and 10 in a million cancer risk as the permit approvable levels. These are consistent with the U. S. EPA's definition of "poses a risk" (U.S. EPA, 1998) and the ARB Risk Management Guidelines (1993).

For the permit denial level, we are recommending the districts use a 10 percent probability of BLLs ≥ 10 µg/dL for neurodevelopmental risk and 100 in a million for cancer risk. This is based on a consideration of achievable emission rates and is consistent with the CDC recommendations and the ARB's Risk Management Guidelines. An analysis of the potential impacts of these recommended levels is found in Section F.

4. Consideration of Facility Contribution for Modification to Existing Sources - Neurodevelopmental Effects

If the facility contribution is less than the approvable level, the district may approve the permit. If the facility contribution is over the approvable level but the overall source risk is less than the denial level, the district may issue a permit based on specific findings. If the overall source risk is greater than or equal to the denial level, the permit is denied. See the neurodevelopmental effects column of Table 6 for the recommended levels. We recommend a facility contribution of 10 percent in consideration of the other sources of exposure.

F. Risk Management Levels for Existing Sources Using the Detailed Approaches (Chapter II. B.)

Table 7 shows the recommended levels for existing sources complying with the Hot Spots Program. We based these recommendations on an evaluation of risk for a number of existing sources and on risk management decisions made by other regulatory agencies.

Table 7 Hot Spots Program Levels for Existing Sources

	Neurodevelopmental Effects	**Cancer**
Notification level	overall source risk ≥ 5% probability of children ages 0-7 years with BLLs ≥ 10 µg/dL or percent facility contribution > 10% (when the probability is > 5% but < 10%).	maximum excess risk due to emissions from the facility ≥ 10/million among all residents and workers
Significant risk level	overall source risk ≥ 5% probability of children ages 0-7 years with BLLs ≥ 10 µg/dL or percent facility contribution > 10% (when the probability is > 5% but < 10%).	maximum excess risk due to emissions from the facility ≥ 10/million among all residents and workers
Unreasonable risk level	overall source risk ≥ 10% probability of children ages 0-7 years with BLLs ≥ 10 µg/dL	maximum excess risk due to emissions from the facility ≥ 100/million among all residents and workers

G. Impact of the Recommended Levels

In this section, we examine some of the potential effects of these recommended risk management levels. In Table 8, we present the estimated air concentrations that would be associated with the proposed neurodevelopmental risk management levels for the two exposure scenarios in the Tier I analysis. The concentrations shown in Table 8 were calculated from the risk management levels. To evaluate where a specific source would fit, a person would need to know the source emissions and do the appropriate air dispersion modeling.

Table 8 Air Concentrations Associated with Proposed Neurodevelopmental Risk Management Levels

	High Exposure Scenario	**Average Exposure Scenario**
Approvable level	< 0.12 μg/m^3 (based on $\geq$ 10 percent contribution to the mean BLL)	< 0.30 μg/m^3
Approvable level with specific findings required	≥ 0.12 μg/m^3 and < 0.26 μg/m^3	≥ 0.30 μg/m^3 and < 0.55 μg/m^3
Permit denial level	≥ 0.26 μg/m^3	≥ 0.55 μg/m^3
Public notification	≥ 0.12 μg/m^3 (based on $\geq$ 10 percent contribution to the mean BLL)	≥ 0.30 μg/m^3
Significant risk level	≥ 0.12 μg/m^3 (based on $\geq$ 10 percent contribution to the mean BLL)	≥ 0.30 μg/m^3
Unreasonable risk level	≥ 0.26 μg/m^3	≥ 0.55 μg/m^3

As Table 8 shows, any facility with a percent contribution greater than 10 percent must make public notification. People who are aware of the high level of risk may be able to take action to reduce the exposure. A Specific Findings Report would be required for any new facility or modification to an existing facility in a high exposure area if we did not consider the percent contribution. Our initial assessment of the census tracts in Los Angeles County indicates about 17 percent of the census tracts would qualify as high exposure areas.
will not drive any risk management decisions but would be a contributing risk for sources that emit other carcinogens.

Table 9 shows the air concentrations that would be associated with the proposed levels for cancer risk.

There is an apparent contradiction in allowing a new facility to be permitted at an air concentration that would trigger a risk reduction audit and plan for an existing source. However, permitting decisions are typically based on the maximum operating capacity of the facility and Hot Spots Program assessments are based on actual emissions which are typically less than the maximum capacity.

Table 9 Lead Air Concentrations Associated with Cancer Risk Management Levels.

Risk Management Levels	Lead Concentration (inhalation only)
Approvable level	$< 0.84\ \mu g/m^3$
Approvable level - specific findings required	$\geq 0.84\ \mu g/m^3$ but $< 8.4\ \mu g/m^3$
Permit denial level	$\geq 8.4\ \mu g/m^3$
Public notification	$\geq 0.84\ \mu g/m^3$
Significant risk level - Risk must be reduced to the designated significant level within 5 to 10 years	$> 0.84\ \mu g/m^3$
Unreasonable level risk - risk must be reduced within 5 years or less	$\geq 8.4\ \mu g/m^3$

H. Additional Requirements

Health and Safety Code (H&SC) section 42301.6 (a) states that prior to approving a source application for a permit to construct or modify, the Air Pollution Control Officer (APCO) must determine if the source is within 1000 feet from the boundary of a school site. If the source is located within 1000 feet of the school site, the APCO must prepare a public notification describing the proposed project or modification. At the expense of the permit applicant, the APCO must distribute or mail the notice to the parents or guardians of children enrolled in any school within one-quarter mile of the of the source and to each address within 1,000 feet of the source (H&SC section 42301.6(b)). The notices must be sent at least 30 days prior to the date the APCO takes final action.

Note that the school in H&SC section 42301.6(b) is not necessarily the same as the school site in HS&C section 42301.6(a). H&SC section 42301.9 defines "school" as "any public or private school used for purposes of the education of more than 12 children in kindergarten or any of grades 1 to 12 inclusive, but does not include any private school in which education is primarily conducted in private homes." "School site" is not defined, but legislative history indicates that school site refers to property acquired for past or future school construction (Statutes 1991, Chapter 1183). If the source is within 1,000 feet of the outer boundary of a school site, notification is required. Neither a school building nor enrolled children are necessary for this requirement to apply.

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